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GB 1131721
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(54) PRODUCTION OF METAL STRIP

(57) A method of producing ferrous metal strip from iron ore comprising the steps of beneficiating the ore into a concentrate powder form, forming the powdered ore into pellets, passing the ore pellets through a furnace in the presence of a reducing gas acting as the sole or primary reductant and compacting the reduced pellets in the nip of a rolling mill to produce a strip of ferrous metal. The reduced pellets may pass to the rolling mill at the furnace temperature, or at a lower temperature followed by a sintering step. The step may be subsequently hot-rolled.

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FIG.1.

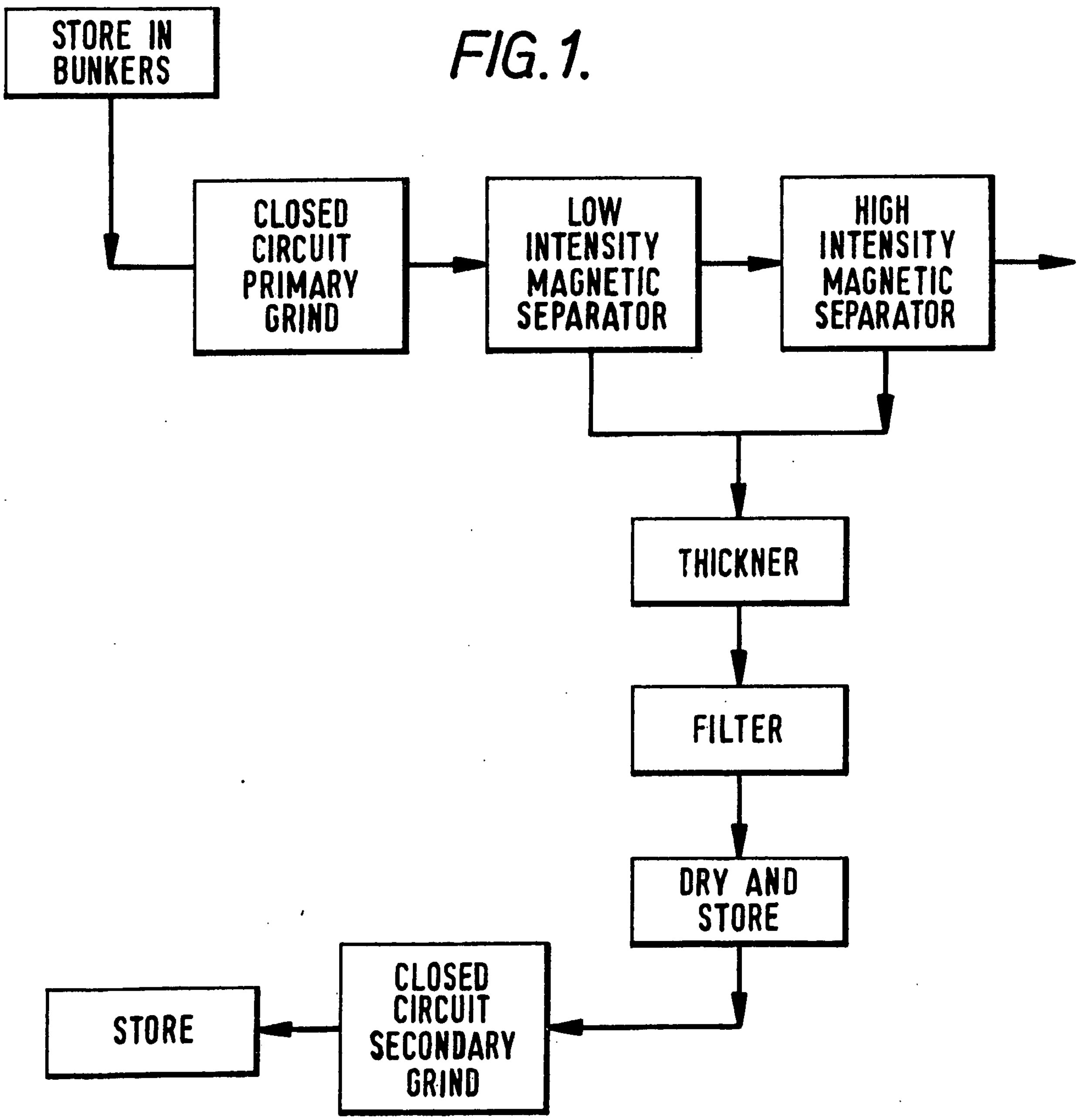
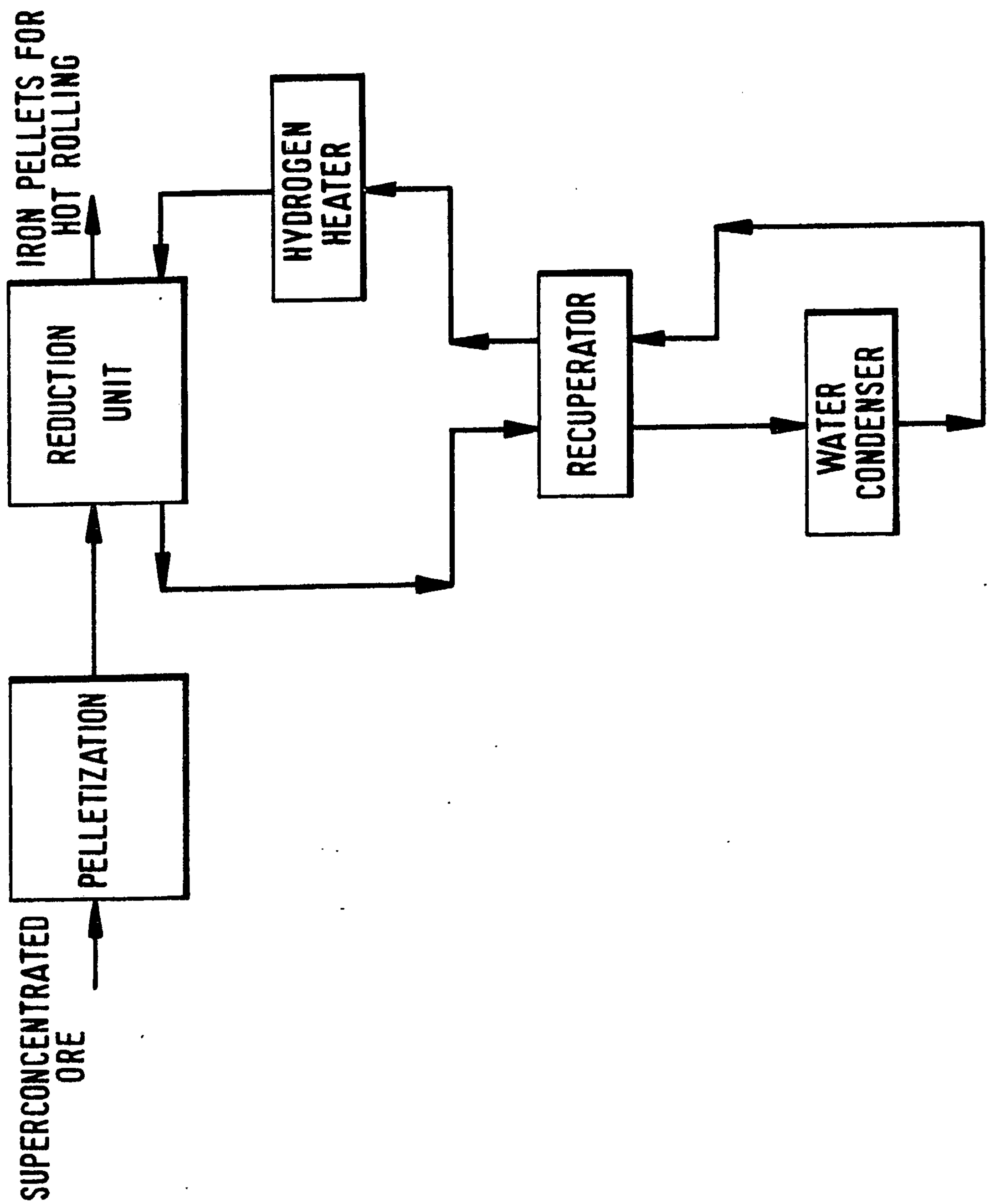
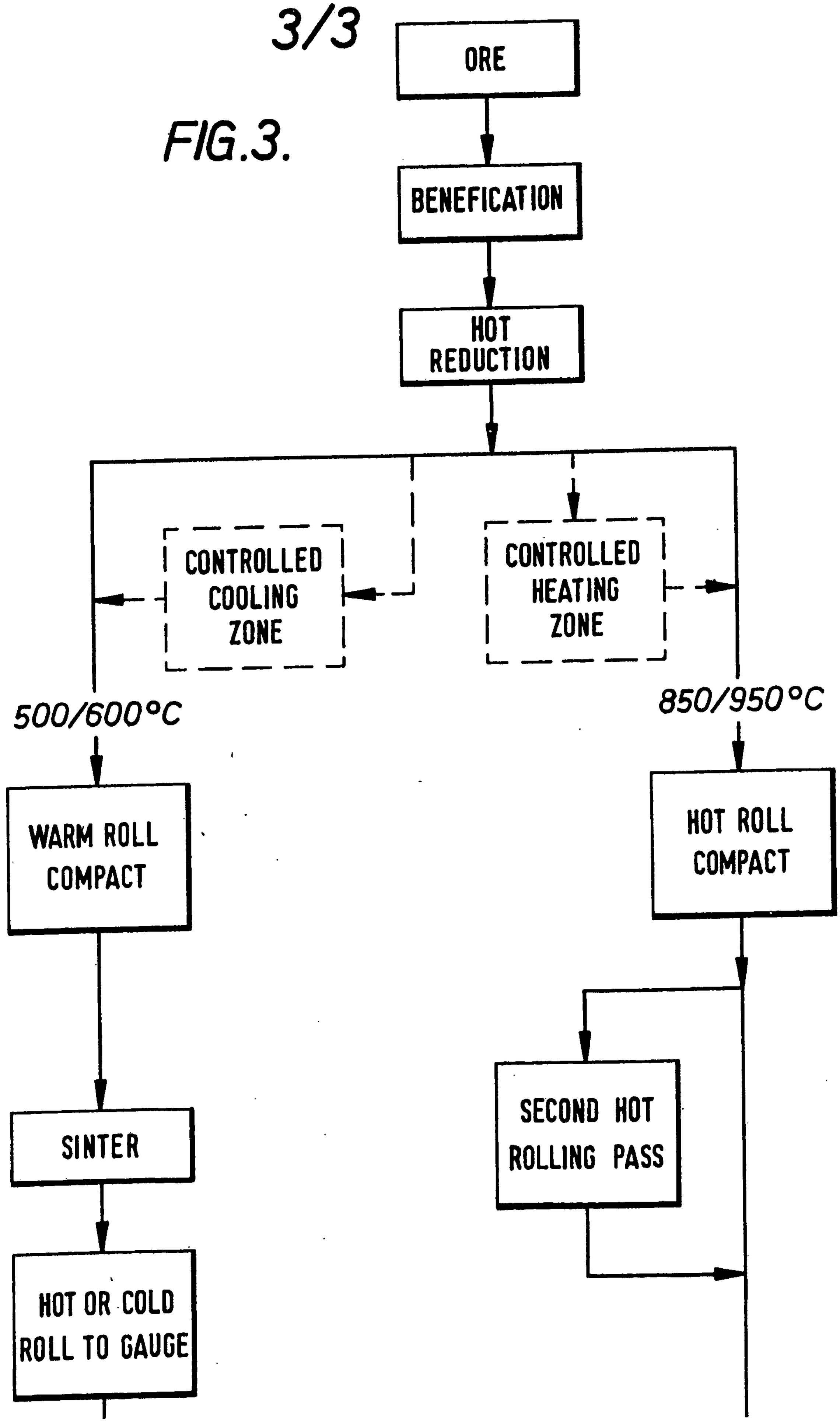

STORE IN BUNKERS
CLOSED CIRCUIT PRIMARY GRIND
LOW INTENSITY MAGNETIC SEPARATOR
HIGH INTENSITY MAGNETIC SEPARATOR
THICKNER
FILTER
DRY AND STORE
CLOSED CIRCUIT SECONDARY GRIND
STORE

FIG. 2.


SUPERCONCENTRATED ORE
PELLETIZATION
REDUCTION UNIT
IRON PELLETS FOR HOT ROLLING
HYDROGEN HEATER
RECUPERATOR
WATER CONDENSER

3/3

FIG.3.


ORE
BENEFICATION
HOT REDUCTION
CONTROLLED COOLING ZONE
CONTROLLED HEATING ZONE
500/600°C
850/950°C
WARM ROLL COMPACT
HOT ROLL COMPACT
SINTER
SECOND HOT ROLLING PASS
HOT OR COLD ROLL TO GAUGE

SPECIFICATION

PRODUCTION OF METAL STRIP

This invention relates to the production of ferrous metal strip from an iron ore starting material and it is an object of the present invention to provide a new or improved method of manufacturing such metal strip.

In accordance with the invention there is provided a method of producing ferrous metal strip from iron ore comprising the steps of beneficiating the ore into a concentrate powder form, forming the powdered ore into pellets, passing the ore pellets through a furnace in the presence of a reducing gas acting as the sole or primary reductant and compacting the reduced pellets in the nip of a rolling mill to produce a strip of ferrous metal.

The iron ore may be beneficiated into concentrate powder form by subjecting the ore to a series of grinding, magnetic or gravity separation and filtration stages.

Alternatively chemical (e.g. chloride) beneficiation may be utilised.

The reduction of the ore pellets may be carried out in a furnace in a continuous or batch mode of operation in the presence of hydrogen and/or carbon monoxide or any other suitable reducing gas or gases.

The reduced pellets may be fed direct to the compaction rolling mill from the reducing furnace at substantially the temperature of the furnace and the compacted strip may then be subjected to a further hot rolling stage. Alternatively, the reduced pellets may be fed to the compaction mill at a lower temperature than that which was attained in the reducing furnace and the compacted strip may then be subjected to sintering and further hot or cold rolling stages.

Alternatively again, the reduced pellets may be heated after the reduction stage and before being fed to the compaction mill dependent upon the temperature in the reducing furnace.

Examples of the invention will now be described in more detail with reference to the accompanying drawings wherein:

Figure 1 is a block diagram of a series of ore beneficiation stages;

Figure 2 is a block diagram of one example of the pelletising and reduction stages; and

Figure 3 is an overall block diagram of an example of all of the stages of the method.

Referring to Figure 1 of the drawings, iron ore is conveyed from a dry store to a closed-circuit primary grinding mill which may be of the type manufactured by the Alice Chalmers Corporation from which the ground ore is passed through successive low and high intensity magnetic separators which may be of the type manufactured by Boxmag Rapid. The non-magnetic content is pumped out of the separators, whilst the magnetic content is then passed to a thickener which may be of the type manufactured passed through a filter which may be of the rotary disc type manufactured by Dorr-Oliver and after drying the ore is then subjected to a final closed-circuit grinding operation.

At this stage the beneficiation of the ore is complete and is in a concentrate powder form having a Blaine size range of 1300—2200. The gangue content of the ore is conveniently of less than 5%. The beneficiated ore is then passed to a pelletising unit which may be of the type manufactured by the Head Wrightson Group from which the pelletised ore is passed to a reduction furnace. The pellet size of the ore is conveniently less than 12 mm.

The reduction furnace may be a shaft furnace or a travelling grate kiln and in the furnace the pelletised ore is subjected to the action of a reducing gas which conveniently and as illustrated in Figure 2 is hydrogen. Conveniently the reduction furnace operates at a temperature within the range 500°C to 1000°C.

The reduced pellets may be removed from the reducing furnace in either a continuous or batch mode of operation dependent upon the type of furnace which is utilised. Thereafter the reduced pellets may be subjected to a rolling sequence, two examples of which are shown in Figure 3 of the drawings. In the first example, the reduced pellets are fed directly from the reduction furnace at a temperature within the region 500°C to 600°C, or after cooling to such temperature, dependent on the operating temperature of the reduction furnace, vertically into the nip of a compaction mill to produce a coherent strip of metal. Subsequently the metal strip is passed through a sintering furnace and may then be subjected to further hot or cold rolling to reduce the strip to the desired thickness and density.

In the second example, the reduced pellets are fed directly from the reduction furnace at a temperature within the region 850°C to 950°C, or after heating to such temperature, dependent on the operating temperature of the reduction furnace, vertically into the nip of a compaction mill to produce a coherent strip of metal. Although a rolling temperature of 850°C—950°C is exemplified herein it should be appreciated that rolling temperatures in excess of 950°C may be utilized. The hot strip may then be subjected to a further hot rolling stage and any subsequent rolling stage as may be desired to reduce the strip to its desired thickness and density.

Again although rolling temperatures in two separated ranges have been exemplified, rolling temperatures in the intervening range of 600°C to 850°C are perfectly feasible, and indeed can be most effective. Within this intervening range subsequent sintering may be carried out on the strip.

The initial compaction, as mentioned herein, is carried out by feeding the reduced pellets vertically into a roll nip and preferably this is accomplished via a hopper above the roll nip

uniformly across the width of the roll gap. The pellets from the reducing furnace are preferably transported to the compaction mill under a protective atmosphere. Such atmosphere would be reducing and may comprise nitrogen with the addition of hydrogen at a concentration below the explosive limit, e.g. 5% by volume.

Conveniently the mass per unit volume of the pellets in the feed zone to the roll nip may be optimised by utilising a mix of pellet sizes. For example a three size-component mix may be utilised comprising 85% by weight of pellets of diameter 'd'; 10% by weight of pellets of diameter 'd/2' and 5% by weight of pellets of diameter 'd/4'.

In a laboratory scale operation we have found the method described to be particularly effective when, for example, the pellets are of a size such that d is of the order of 2.5 mm.

CLAIMS

1. A method of producing ferrous metal strip from iron ore comprising the steps of beneficiating the ore into a concentrate powder form, forming the powdered ore into pellets, passing the ore pellets through a furnace in the presence of a reducing gas acting as the sole or primary reductant and compacting the reduced pellets in the nip of a rolling mill to produce a strip of ferrous metal.

2. A method according to Claim 1 wherein the iron ore is beneficiated into concentrate powder form by subjecting the ore to a series of grinding, magnetic or gravity separation and filtration stages.

3. A method according to Claim 1 wherein the iron ore is beneficiated into concentrate powder form by chemical means.

4. A method according to Claims 1, 2 or 3 wherein the gangue content of the beneficiated ore is less than 5%.

5. A method according to any one of the preceding claims wherein the pellet size of the ore is less than 12 mm.

6. A method according to any one of the preceding claims wherein the reduction of the ore pellets is carried out in a furnace in a continuous operation in the presence of hydrogen and/or carbon monoxide.

7. A method according to any one of Claims 1 to 5 wherein the reduction of the ore pellets is carried out in a furnace in a batch mode of operation in the presence of hydrogen and/or carbon monoxide.

8. A method according to any one of the preceding claims wherein the reduced pellets are fed direct to the compaction rolling mill from the reducing furnace at substantially the temperature of the furnace.

9. A method according to Claim 8 wherein the compacted strip is subjected to a hot rolling stage.

10. A method according to any one of Claims 1 to 7 wherein the reduced pellets are fed to the compaction rolling mill at a reduced temperature than that attained in the reducing furnace and the compacted strip is then subjected to sintering and further rolling stages.

11. A method of producing ferrous metal strip substantially as hereinbefore particularly described.

12. Ferrous metal in strip form produced by a method according to any one of the previous claims.

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